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Assessing the suitability of existing spatial data for disaster planning and mitigation in Queensland

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The Council of Australian Governments (COAG) in 2003 gave in-principle approval to a best-practice report recommending a holistic approach to managing natural disasters in Australia incorporating a move from a traditional response-centric approach to a greater focus on mitigation, recovery and resilience with community well-being at the core. Since that time, there have been a range of complementary developments that have supported the COAG recommended approach. Developments have been administrative, legislative and technological, both, in reaction to the COAG initiative and resulting from regular natural disasters.

This paper reviews the characteristics of the spatial data that is becoming increasingly available at Federal, state and regional jurisdictions with respect to their being fit for the purpose for disaster planning and mitigation and strengthening community resilience. In particular, Queensland foundation spatial data, which is increasingly accessible by the public under the provisions of the Right to Information Act 2009, Information Privacy Act 2009, and recent open data reform initiatives are evaluated.

The Fitzroy River catchment and floodplain is used as a case study for the review undertaken. The catchment covers an area of 142,545 km^2, the largest river catchment flowing to the eastern coast of Australia. The Fitzroy River basin experienced extensive flooding during the 2010–2011 Queensland floods. The basin is an area of important economic, environmental and heritage values and contains significant infrastructure critical for the mining and agricultural sectors, the two most important economic sectors for Queensland State. Consequently, the spatial datasets for this area play a critical role in disaster management and for protecting critical infrastructure essential for economic and community well-being. The foundation spatial datasets are assessed for disaster planning and mitigation purposes using data quality indicators such as resolution, accuracy, integrity, validity and audit trail.

Key Words : *disaster management, risk mitigation, spatial data, community well-being, community resilience*

1. INTRODUCTION

The Council of Australian Government (COAG) in 2003 gave in-principle approval to the recommendations of *Natural Disasters in Australia: Reforming mitigation, relief and recovery* – a best-practice report recommending a holistic approach to managing natural disasters in Australia. The recommendations of the report, developed by a high level group (HLG) of senior representatives from all levels of Australian government, were framed to move from a traditional response-centric approach to a greater focus on mitigation, recovery and resilience with community well-being at the core. This approach represented a historic move from a focus on disaster response and reaction towards anticipation and mitigation[1)].

The HLG also recommended a comprehensive five-year package of twelve commitments to reform the way Australia manages natural disasters such as floods, bush-fires and tropical cyclones. In the context of access to and the suitability of spatial data for disaster planning and mitigation, the following recommendations were made:

- develop and implement a five-year national programme of systematic and rigorous disaster risk assessments;
- establish a nationally consistent system of data collection, research and analysis to ensure a sound knowledge base on natural disasters and disaster mitigation;
- develop for each level of government, a natural disaster mitigation strategy to be implemented by the Commonwealth and each State and territory commencing in year 2, and by Local Government commencing in year 3;
- take action to ensure more effective statutory state, territory and local government land use planning, development and building control regimes that systematically identify natural hazards and include measures to reduce the risk of damage from these natural hazards;
- develop jointly improved practices in community awareness, education, and warnings which can be tailored to suit state, territory and local circumstances[2)].

In December 2009, COAG agreed to a whole-of-nation resilience-based approach to disaster management, recognising that a national, coordinated and cooperative effort was needed to enhance Australia's capacity to withstand and recover from emergencies and disasters. This agreement followed a 2008 recommendation from the Ministerial Council for Police and Emergency Management that Australian emergency management should be based on achieving community and organisational resilience[2)]. The above discussion outlines the genesis for the creation of the national disaster resilience strategy.

2. NATIONAL STRATEGY FOR DISASTER RESILIENCE

Application of a resilience-based approach is not solely the domain of emergency management agencies; rather, it is a shared responsibility between governments, communities, businesses and individuals. The purpose of the Strategy was to provide high-level guidance on disaster management to Federal, state, territory and local governments, business and community leaders and the not-for-profit sector. The recommendations were contained in the report, *National Strategy for Disaster Resilience - Building the resilience of our nation to disasters*, which focused on priority areas to build disaster resilient communities across Australia. The Strategy was considered a first step in a long-term, evolving process to deliver sustained behavioural change and enduring partnerships. In particular, the Strategy was to inform local action and develop a shared understanding of the critical part they play in developing their own disaster resilience and that of their communities[2)].

The Strategy recommendations, of intrinsic value with respect to access to and the suitability of spatial data included:

- Consistent methodologies and data frameworks should be applied in risk and disaster impact assessments to enable information sharing and accurate interpretation.
- Partnerships should be in place, which support improved access to risk information and to provide more effective collaboration in assessing and monitoring hazards and risks common across jurisdictional boundaries.
- As a matter of routine, organisations, individuals and governments should share information and risks maps for the benefit of the community.
- Creation of strong networks across sectors and regions to fill information gaps, share information and build understanding at all levels.
- Understanding costs and benefits associated with hazard management and for informing risk reduction activities.
- Ensure emergency messages are clear and, where appropriate, nationally consistent.
- Ensure existing and, where necessary, improved data and tools for assessing hazards and risks to enable communities to better understand and act on their risks[2)].

The reference to availability and accessibility to data is most obvious in these recommendations. Therefore, it is important to review what has been put in place in response to facilitate access to spatial data suitable for disaster planning and mitigation.

3. HISTORICAL ASPECTS OF QUEENSLAND DEVELOPMENTS RELATED TO COAG RECOMMENDATIONS

Queensland Government adopted the State Planning Policy 1/03 which took effect on September 1, 2003. The policy*, Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* was made under Schedule 4 of the Integrated Planning Act 1987 and set out the State's interest in ensuring that the natural hazards of flood, bushfire and landslide were adequately considered when making decisions about development. The policy document distinguished between natural hazards and natural disasters whilst highlighting the requirement for information for the identification of natural hazard management areas. Information identified as being required include: floodplain areas; the likely severity of a natural hazard; slope calculation for landslide hazards; predicted reductions in annual rainfall and increase in rainfall intensity; sea level and coastal erosion; bushfire risk and flood risk; and damage to transport infrastructure and low-lying human settlements[3)].

The Queensland Spatial Information Council (QSIC) is part of the Land and Spatial Information Group in the Department of Natural Resources and Mines (DNRM). QSIC and its predecessor organisations have provided a high-level forum for co-ordination and management of policy for Queensland's spatial information through participation of state and local government agencies, and the private, professional and academic sectors. QSIC also provides linkages to national spatial initiatives as a member of the Australia and New Zealand Land Information Council (ANZLIC). The QSIC Strategic Plan outlines four goals which includes the need to ensure that foundation spatial information is easily accessible[4)].

Spatial information is governed by a series of four information standards developed by QSIC for use by the spatial information industry. These include, Foundation Spatial Data, Parcel Identification, Digital Road Network, and Custodianship[5)]. QSIC Spatial Advisory Group has determined that the following spatial data themes as foundation for Queensland built environment; Cadastre, Elevation, Geospatial Reference Frame, Hydrography, Imagery, Land Resources and Place Names and Location Address. DNRM, as the lead spatial agency in Queensland, also have assesed their fundamental data themes with the view of closer alignment with the QSIC foundation spatial data themes[6)].

In December 2012, the Queensland Government announced the formation of an Open Data Revolution (ODR). Open data is focused on the basic or 'raw' data collected, generated and stored by the Queensland Government as a consequence of its jurisdictional and statutory responsibilities. The data has a diversity of information including attributes such as, performance of our hospitals and schools, traffic information and crime statistics, demographic details, and geospatial data. The raw data has been subject to limited analysis and cross-checking. The Queensland Government has stated its intention to release data that is correct, complete and up-to-date. Limitations identified are that the data may include inconsistencies and some information cannot be released due to privacy or confidentiality grounds. State agencies will be required to release data complying with stipulated standards, such as: compliance with metadata standards; application of clear licences (preferably open such as under Creative Commons); assessing and advise on data quality; and outlining any limitations on data use[7)].

The first manifestation of ODR has been the release, in March 2013, of the Queensland Globe, which is a free plug-in developed by the Queensland Government allowing the viewing of a wide range of spatial data through Google Earth, including, addresses, localities and boundaries, road and rail networks, land parcels and tenure, areas affected by flooding, and topographical maps. The Globe is a tool that links to the Queensland Spatial Portal providing access to Queensland Government Information Service (QGIS), which has 690 datasets available for downloading representing the datasets provided by eight state government departments[8)].

4. DEFINING THE SUITABILITY OF AVAILABLE SPATIAL DATA FOR DISASTER PLANNING AND MITIGATION

The need for access to suitable spatial data and information has been recognised as fundamental to robust disaster planning and mitigation. Consequently, the primary question that arises is what defines suitable spatial data and information. Table l illustrates the types of management operations required along with the appropriate level of data required to arrive at an informed decision. A system's ability to aggregate data collected for operational purposes is important for planning and decision making, thus allowing use by various levels or types of decision makers[9]. Although Table 1 was prepared specifically as part of the justification for the establishment of land information management systems, the classification is considered relevant as current spatial data infrastructure have evolved based on Dale and McLaughlin's pioneering work[9]. The categories are just as applicable to the various decisions made utilising geographic information systems and other geospatial technologies during the disaster management cycle: recover, prevent, prepare, respond[10].

The characteristics of spatial data to be suitable for disaster planning and mitigation must be fit for the purpose of meeting the requirements of each of the decision categories. Prior to the recent natural disaster events in Queensland, spatial data with or nearing state-wide coverage was collected to meet state agency statutory or jurisdictional requirements albeit in accordance with national standards adopted by ANZLIC.

Table 1 Information Requirements by Decision Category[9]

CHARACTERISTIC OF INFORMATION	OPERATIONAL CONTROL	MANAGEMENT CONTROL	STRATEGIC PLANNING
Source	Largely internal	←– – – – – – – – – – →	External
Scope	Well defined, narrow	←– – – – – – – – – – →	Very wide
Level of aggregration	Detailed	←– – – – – – – – – – →	Aggregate
Time horizon	Historical	←– – – – – – – – – – →	Future
Currency	Highly current	←– – – – – – – – – – →	Quite old
Required accuracy	High	←– – – – – – – – – – →	Low
Frequency of use	Very frequent	←– – – – – – – – – – →	In frequent

Although considerable progress had been made following the COAG initiatives for access to such data with the publication of fundamental spatial data standards, including metadata standards, the operational demands for spatial data during the response and recover stages quickly highlighted critical time and response delays. The need for considerable re-working of data received from one agency to be combined with data obtained from others was quite evident. Furthermore, there was also the discovery that some data of even a minimum suitable characteristic was just not available.

Dale and McLaughlin (1986)[9] also proposed two approaches for assessing the characteristics of data; spatial and non spatial. The first being: source, acquisition techniques, spatial content, textural content, timeliness (requirement for up-dating), maintenance time frame, accuracy, processing and display requirements, political and financial considerations of holding such data, the national security and private citizen right of privacy issues. The second being: currency, precision, accuracy, quantifiable, verifiable, accessible, freedom from bias, comprehensive, appropriateness, and clarity. Such criteria are admirable in a perfect world but particularly in the response and immediate recovery phases of a natural disaster, the best-available data is inevitably employed for the purpose. Dale and McLaughlin's[9] approaches have been fairly well superseded by ISO 19115 Geographic Information – Metadata from ISO/TC 211. This current, "best practice" International Standard provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data. The Standard is applicable to digital data, but its principles can be extended to many other forms of geographic data such as maps, charts, and textual documents as well as non-geographic data[11]. The standard is published in Australia and New Zealand as AS/NZS ISO 19115:2005. Assessing the suitability of ISO 19115 is not within the scope of this paper.

In the context of a modern GIS, the data quality refers to five key components; accuracy, precision, consistency, completeness ad lineage. However, the capture of primary geographic and geospatial datasets for the phases of disaster planning and mitigation is increasingly being undertaken by remote sensing technologies. For utilization of remotely sensed data in a GIS, resolution is a key physical characteristic of the remote sensing system. The three key aspects of resolution are spatial, spectral and temporal[12].

5. AGENCY INITATIVES AND RESPONSES TO COAG STRATEGIES

Investigations of the responses to COAG initiatives by agencies that have a key role during any of the phases of a disaster management cycle were undertaken. Discussions were conducted with representatives of these agencies and with representatives of other agencies contributing and or utilising spatial data during the cycle that commenced in December 2010. The discussions were focused on determining lessons learnt and measures undertaken as a result of the Queensland 2010/11 flood event and other natural disasters that resulted in a positive influence during the prevention, preparation, response and recovery phases of the 2012 and 2013 natural disaster events. A synopsis of the discussions undertaken are given below.

5.1 Queensland Reconstruction Authority (QRA)

QRA was established following the 2010/11 disaster events. The Authority's mission is to reconnect, rebuild and improve Queensland communities and its economy. The Authority's role was subsequently extended to also cover historical and continuing disaster events in Queensland[13)]. Since its establishment, QRA has evolved a role as a 'point of truth' for matters related to reconstruction of the State's infrastructure utilising a website to compile and disseminate information related to its jurisdictional responsibilities. Considering the focus of this paper, the QRA website has a 'Maps' link for access to spatial datasets including: Interactive Floodcheck Map; Aerial imaging and mapping (before and after flood); and Floodplain maps[14)]. The latter two datasets were prepared and made accessible as a direct response to the recommendations contained in the Queensland Floods Commission of Enquiry – Final Report[15)]. These datasets are appropriate for the information requirements for making decisions at least at the Management Control and Strategic Planning category level given in Table 1.

Queensland's ability to recover from natural disasters has been significantly enhanced with the development of a system that enables the gathering of early and accurate information for timely damage assessments. DARMsys™ (Damage Assessment and Reconstruction Monitoring system), introduced as a pilot program in April 2011, is employed to monitor the re-building progress. Real time data is collected by assessors using a hand held monitoring device and sent via wi-fi to provide map based damage data. QRA officers use the system to travel through disaster-affected communities to identify where the greatest needs exist, to assist the provision of assistance to the most vulnerable in the community. DARMsys™ information has proved invaluable to State Disaster Management Group and is now in use by all relevant agencies to plan their response for recovery from natural disaster events. The Department of Communities now use the system to target and identify vulnerable people needing assistance. Others who are using it include utility providers, public works, temporary housing planners and councils[16)].

5.2 Department of Natural Resources and Mines (DNRM)

The immediate response by DNRM to the Queensland 2010/11 flood event and natural disasters has been discussed previously by Hayes and Goonetilleke (2012)[17)]. The most recent initiative has been the release of the Queensland Globe. In the intervening period, DNRM, in conjunction with other state agencies and local authorities, has coordinated the acquisition of high resolution imagery at 15cm or better over flood towns to coincide with flood peaks (including before and after flood event). Lidar information appropriate for the production of mapping at the resolution of 0.25 metre contour intervals and other spatial products was also commissioned. The imagery and Lidar spatial products were utilised by DNRM, as tasked by QRA, to undertake the mapping of floodplains on a state wide basis. The flood lines can now be accessed at the QRA website. DNRM has reported that the processes developed during the 2010/11 events are able to streamline both the determination and mapping of the floodline and insurance claims payment process during the Bundaberg 2013 flood event[18)].

QSIC, part of the Land and Spatial Information Group in DNRM, took a leading role in the discussions and developments leading to accessing of spatial datasets through a Creative Commons licencing framework, leading in turn to the enactment of the *Right to Information Act 2009*, which, in cohort with the *Information Privacy Act 2009* replaced the *Freedom of Information Act 1992*[19)]. Without this legislation in place, the Open Data Revolution and Queensland Globe would not likely have occurred. QSIC has also established the QSIC/Ergon ROAMES Spatial Reference Group whose purpose is to consider issues arising from the Ergon ROAMES project as they relate to the spatial industry. Particular concern of the reference group relates to: information management, data issues, applications, communication, capability and the roles and interactioin of government and the private sector. The group is also providing advice and assistance to Ergon (the Queensland Government owned Corporation supplying electricity in regional areas) on matters relevant to the spatial industry and to explore how best to influence the project to optimise opportunities for the spatial industry[20)]. (The ROAMES project is discussed in more detail in Section 5.5 below).

5.3 Department of Community Safety – Emergency Management Queensland (EMQ)

EMQ coordinates Queensland emergency and disaster management arrangements and disaster mitigation programs. EMQ provides the core staffing for the Queensland Disaster Management System and manages the State Emergency Service (SES), Emergency Service Unit volunteers (ESU) and EMQ Helicopter Rescue and Emergency Services Cadets[21)]. EMQ is responsible for disaster preparedness, disaster awareness and the coordination of various rescue, response and recovery services in the state. The division works closely with the Bureau of Meteorology and coordinates volunteers for disaster clean-up operations. EMQ maintains a disaster management website where links, information and administrative forms can be accessed to help prepare for, respond to and recover from disasters[22)].

The GIS Unit of the Queensland Fire and Rescue Service. confirmed a more-informed community of users, resulting from the recent natural disaster events, is facilitating a better appreciation of the spatial data products that might be made available during any of the four phases of the disaster management cycle. An ongoing problem notwithstanding recent data access and sharing initiatives, is the maninpulation necessary to format datasets captured for jurisdictional and statutory requirements to meet the requirements for the disaster management cycle, especially for the response phase[23)].

5.4 Department of Transport and Main Roads (TMR)

The 131940 Traffic & Travel Information (TTI) website, developed in 2001, is owned and operated by TMR. It aims to provide Queensland road users with a real-time view of activities occurring on major state roads to allow travelers to make informed travel decisions. The different types of traffic and travel information provided on the 131940 website include:

- Traffic incidents - timely updates on traffic incidents, such as crashes, and their location, to enable users to make informed decisions about their journey.
- Roadworks - reports on scheduled and unscheduled (emergency) roadworks, their location and the potential delays these are expected to cause to traffic.
- Special events - road closures planned in advance generally relating to sporting or cultural events and the expected delays to traffic.
- Live web cameras - enable access to the fleet of web cameras installed in different areas in Queensland.
- Traffic census data - average daily traffic counts and volumes for various state-controlled roads.
- Closures and limits - Road closures and associated load limits on roads due to wet weather and flooding[24)].

Up until the recent natural disaster events, TMR relied on hard copy maps, personal knowledge, media and state disaster coordination group and regional reports to develop a picture of evolving situations, which involved a heavy reliance on individuals correctly interpreting the situation using personal knowledge and experience. In 2007, with the first flood event following years of drought, TMR no longer had the in-house corporate knowledge and experience in managing floods. There still existed an abundance of data but not a consistent structure to the format and storage of datasets and more importantly, no process to present and display the resultant information to users, particularly during a dynamic evolving event such as a natural disaster. The challenge was to be able to display disparate spatial datasets such as heavy vehicle routes, weather forecasts, road closures, structures including information that were being updated as the event evolved and from which informed decisions, particularly operational and strategic decisions could be based. Queensland Fire and Rescue Service (QFRS) had built a prototype interactive mapping service to display natural hazard data. TMR recognized the potential of a similar interactive mapping system to access in-house corporate knowledge[25)].

Fortuitously, TMR geospatial and IT personnel has been working on and had demonstrated their prototype interactive mapping system, based on the QFRS prototype, before December 14 when the 2010/11 natural disaster events commenced when the Nogoa River in Emerald started to rise. The prototype went live and lessons learnt during the 2010/11 events formed the basis for TMR's interactive mapping project - The Emergency Response Interactive (ERIM), which presents six themes based on emergency event types, namely, flood, cyclone, storm surge, fire, earthquake, maritime and spill. These themes are displayed based on spatial and other aspatial datasets sourced from:

- TMR data – road network and routes; boundaries – cadastral and administrative; Bridge Information System (BIS); transport infrastructure
- Externally sourced data – GeoRSS feeds (NSW Rural Fire Service, USGS Earthquakes); Bureau of Meteorology (BOM) – Web Map Service (WMS) (cyclone tracker, river observations, radar, Mean Sea Level Pressure); Web Feature Service (WFS) (flood warning levels); MODIS (Modis Fire (bushfire monitoring) and Modis flood water.
- Oracle Spatial – bridges and structures; boundaries and borders; localities national address (GNAF) and localities properties (PLI), road network and routes; water areas, lines and catchments; railway.

The integration of the spatial datasets listed for the purpose of decision support activities represents a challenge in a rapidly evolving situation particularly with respect to the externally sourced data as a direct result in disparity of spatial, temporal, and spectral resolution. However, apart from such an observation, TMR have identified the following benefits from the interactive mapping approach: reliable source of live data; a 'single point of truth concept'; facilitates display of the 'big picture' bringing all stakeholders 'on the same page'; facilitates use of data sourced externally; reduces duplication; facilitates 2-way communication including data transfer with key stakeholders[26)].

TMR state that Interactive Maps aid coordination of departmental response to disaster events in Queensland by facilitating the combination of their data with data from BOM and other departments. The ability to produce on demand maps themed by the emergency management phase, namely, planning, recovery, restoration, is believed to be the significant outcome from the development of the interactive mapping system whose products include:

- Emergency Response Map – map themes by emergency event type (flood, cyclone, storm surge, fire, earthquake, maritime and spill);
- Structure Map – structures, bridge material, bridge design class, structure programmes, bridge types, hydraulics, heavy vehicle routes, higher mass limit routes, heavy vehicle restricted areas;
- 131940 Map – closed roads, open to 4WDs and high clearance, open to load restrictions, open with mass/dimension limits, open with caution;
- Road Safety Partnership – crash severity, fatal crashes by speed limit, hospitialisation crashes by speed limit, all crash severities by speed limit, all crash severities by year, all casualties by user type[27)].

TMR technical officers considered the system can effectively meet an evolving demand for spatial products, but were concerned with to the quality the departmental data collected across the jurisdictional regions and the likelihood of a devaluation of information displayed by the interactive mapping[28)].

5.5 Ergon Energy

For Ergon Energy (the Queensland Government owned Corporation suppling electricity in regional areas), flood and inundation data play a valuable role in pre-disaster planning, disaster response restoration, maintenance, planning and design. The agency currently uses QSIS to access fundamental spatial data – vector, raster data and imagery. The agency uses elevation, inundation, flood and imagery data in disaster response situations and proactively in normal business activities such as for network planning and design processes and summer storm season planning. Ergon's priority concerns during disasters include; safety, protection of plant, maintaining power supply, outage restoration and stakeholder communication. Early spatial data in the form of disaster impact information such as projected inundation area, projected flood areas, cyclone path, allows Ergon Energy to perform safe staged disconnections of equipment, re-route power supply around affected areas, prioritise restoration of supply, keep the public and workforce safe and to inform stakeholders of operational activities.

During the 2011/12 flood event and cyclone season, the agency was unable to obtain suitable and flood inundation data via QGIS. Limited information was available in PDF format only. Personal communication resulted in access to flood level, contour and DEM spatial datasets for a number of local government areas although some coverage was limited. Spatial and reporting tools used the data to predict flood impacts on the network, which was deployed to business centres to undertake operational actions. Post event, Ergon accessed imagery and other spatial datasets obtained via personal contacts for restoration and maintenance activities.

Ergon Energy identified two key issues of concern to its disaster planning and mitigation operations. The first being that as the agency does not have in-house hydrological modeling expertise, it has to rely on external parties for the timely supply of elevation information and modelling of storm surge, tsunami and flooding. The second issue being, a belief that web services and cloud computing should be investigated by QSIC to share and deliver vector and imagery data[29)].

Since 2007, Ergon Energy has been developing ROAMES (Remote Observation Automated Modelling Economic Simulation) technology, which will deliver an innovative approach to vegetation and infrastructure management. The technology creates precise, 3D geo-spatial representations of network assets to be displayed in a Google Earth-like database. The project was instigated to find smarter ways of managing the assets and the surrounding environment, which covers approximately 97% of Queensland's land area, by reducing maintenance and planning costs whilst increasing the safety and reliability of electricity supply. Data is being captured from fixed wing aircraft fitted with sensors that include photographic (5cm GSD) and Lidar (<30cm) equipment. Regional town spatial datasets are captured in grid format whilst rural areas as a corridor of 400m width[30)]. The spatial datasets captured is then used to create a precise, virtual representation of the agency's network infrastructure throughout Queensland, providing vital information for more effective and cost efficient maintenance and asset planning[31)]. Access to the ROAMES spatial datasets would prove an invaluable resource if made available particularly for the disaster management cycle phases.

6. FITZORY BASIN

The Fitzroy River catchment in Queensland is discussed as a case study to illustrate the need for reliable spatial data and the validity of current spatial data accessibility protocols. The Fitzroy River catchment covers an area of 142,545 km^2, 8.2% of the total land area of Queensland. The basin is Australia's second largest coastal-draining catchment, and is the largest river catchment flowing to the eastern coast[32)]. There are seven sub-basins, fourteen local government areas, four climatic zones, three significant bio-regions, one internationally and twenty nationally important wetlands, four fish habitat areas, and a total of 219 protected areas[33)]. Arguably the most important aspect of the basin is its adjacency to the World Heritage listed Great Barrier Reef[34)]. The basin is an area of important economic, environmental and heritage values and contains significant infrastructure critical for the mining and agricultural sectors, the two mainstays of Queensland economy.

The combined waterway length of the major tributaries; Nogoa, Comet, Mackenzie, Issac and Dawson River is 20,850 km. Flood producing water may travel up to 750 km from headwaters to the mouth meaning a flood peak can take several days to reach Rockhampton. Long dry spells are followed by intense wet seasons which is likely to only intensify according to global warming predictions. Having an extensive catchment area and and fan-like shape, the Fitzroy Basin is capable of producing large flood heights. The Fitzroy River basin experienced extensive flooding during the 2010–2011 Queensland floods. The occurrence of a natural disaster in the Fitzory Basin has the potential to be a complex event impacting on many aspects of the environmental, economic and social attributes of the overlapping areas of the basin. Can the existing spatial data for disaster planning and mitigation be assessed as suitable for the prevention, preparation, response and recovery phases[35)]?

The Burdekin-Fitzroy Project 2003-2004, a cooperative project by the Regolith and Land Use research area of Geoscience Australia, Queensland's Department of Natural Resources and Mines and the Cooperative Research Centre for Landscape Environments and Mineral Exploration (CRCLEME) resulted in access to geoscience information via a GIS based interactive map and an accompanying report. The datasets – digital and non-digital - were compiled from a range of sources including NRM, Geoscience Australia (GA), CSIRO and private companies. The report was a guide to data available (and its metadata) within the GIS including: geological, geophysical, geochemical, topographic, hydrological, hydrogeological and cadastre information[36)]. This system, although limited to geosciences information themes, provided an examplar of the importance of access to data.

The Fitzory Basin has a long history of natural disaster events. There is complex interaction between the natural and built environments during the disaster management cycle of such events and especially between the datasets required. The ability to access data is just as critical as having a database containing all relevenat themes and meeting all data quality requirements. It can be contended that access, defined as knowing what is available and what is not and its quality as being fit for purpose, is more important than completeness. Can the existing spatial data be assessed as suitable for disaster planning and mitigation? Accepting that knowledge about available spatial data and its quality is just as important if not more so than completeness of information, which will probably never be realized, the answer must be in the affirmative. The functionality of the access available via the interactive map resulting from the 2003-04 project has evolved significantly to that now available via the Queensland Globe.

Additionally, the quality of foundation spatial data has improved progressively particularly over the period commencing with the DNRM initial response to the natural disaster event in January 2011. The increasing availability of and access to high resolution photography and other imagery and high spatial resolution Lidar will provide significant immediate benefits for hydraulic modeling and other prediction dependent on an accurate DEM or contour information. However, it is not just the spatial data quality, resolution and range that has evolved but more importantly, it is the access to the spatial data that has become more suitable. In some circumstances, spatial data has not improved in quality but being able to access the data and its combination with data sourced from disparate sources has leveraged that suitability.

7. CONCLUSION

Natural disaster events are complex occurrences and involve a complex understanding of the interaction between datasets to create information on which decisions are made. At each phase of the disaster management cycle, a wide range of data are a pre-requisite for operational, planning and strategic decision making. It is highly unlikely that a full range of data meeting preferred quality and resolution specifications will be available on demand.

Data collection, at each phase of the disaster management cycle is a long-term investment requiring the ongoing support of all levels of government, the private sector and the community. An ability to access data is just as critical as having a database containing all relevant themes and meeting all data quality requirements. It can be contended that access, defined as knowing what is available and what is not and its quality as being fit for purpose, is more important than completeness.

Disaster planning and mitigation activities demand spatial data of a quality that is effective, standard, and predictable – a demand that is being met by an evolving, broadly effective data quality management regime and is driving the development of standardised interfaces and services. The spatial data utilised for disaster planning and mitigation are sourced from many sources. The pressing need is for a simple reliable way to assess whether the data are fit for purpose as the data are merged or shared.

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